**Percutaneous Endoscopic Lumbar**

**Discectomy for Adolescent Lumbar**

**Disc Herniation:**

**Surgical Outcomes in 46 Consecutive Patients**

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**Abstract**

***Background:*** The surgical outcome of percutaneous endoscopic **lumbar discectomy** (PELD) for adolescent **lumbar** disc herni-

ation has rarely been reported on. We performed this study to evaluate the surgical outcome of PELD for adolescent **lumbar** disc

herniation.

***Methods:*** We analyzed the surgical outcomes in 46 consecutive adolescent patients between 13 and 18 years of age (mean

age, 16.5 years) who underwent PELD for single level **lumbar** disc herniation from June 2000 to May 2002. Using the clinical

charts and mailed questionnaires, we evaluated the patients preoperatively by the postoperative Visual Analogue Scale (**VAS**) for

back and leg pain, and by the postoperative Macnab criteria.

***Results:*** PELD was performed at L3 – 4 on one patient, at L4 – 5 on 40 patients and at L5 –S1 on 5 patients. One patient com-

plained of transient dysesthesia after the operation. Another patient underwent subsequent open **discectomy** because only incom-

plete decompression was achieved with PELD. At a mean follow-up duration of 37.2 months (range: 25–48 months), the mean

**VAS** scores of both the back and leg pain decreased significantly. In terms of the Macnab criteria, 91.3% of the patients showed

excellent or good outcomes. Recurrent disc herniation developed in one patient 14 months after surgery.

***Conclusions:*** Adolescents who underwent PELD for single level soft **lumbar** disc herniation showed favorable results that

were comparable to the results of open **discectomy**.

**Key Words:**Adolescent, **lumbar**, disc herniation, percutaneous endoscopic **lumbar discectomy** (PELD).

**Introduction**

**LUMBAR** DISC HERNIATION is a rare clinical condi-

tion in children. Adolescent **lumbar** disc hernia-

tions are only 1 – 5% of all the **lumbar** disc hernia-

tions that undergo surgery (2, 3). Open **discectomy**

has been considered a standard treatment for ado-

lescent soft **lumbar** disc herniation (4–12); how-

ever, the long-term outcomes of open **discectomy**

have not always been as good as the short-term

outcomes, and a significant number of patients suf-

fer from residual back pain on long-term follow-up

(7, 12–15). A minimally invasive surgical tech-

nique, chemonucleolysis, has been performed by

several surgeons and has showed results similar to

or better than those of open **discectomy** (2,

16–18). However, this technique has not gained

popularity because of the possibility of severe

complications such as systemic reaction or trans-

verse myelitis (19).

With the rapid evolution of surgical instruments

and techniques for minimally invasive spine surgery,

percutaneous endoscopic procedures for adult lum-

bar disc herniation have shown results that are com-

parable to those of open **discectomy**, even in cases of

recurrent disc herniation (20–30). The main con-

cept of percutaneous endoscopic **lumbar discectomy**

(PELD) has evolved from indirect decompression of

the central disc to a direct targeted fragmentectomy

(20, 31). Based on the successful results of PELD

for adult **lumbar** disc herniation, we thought that

PELD might also be a good treatment option for

adolescent **lumbar** disc herniation. However, the

surgical outcomes of PELD for soft disc **lumbar** her-

niation in adolescents have rarely been reported on

(32). The purpose of this study was to evaluate the

surgical outcome of PELD in 46 consecutive ado-

lescent patients with **lumbar** disc herniation.

**Materials and Methods**

**Patient Population and Outcome Evaluation**

A retrospective review was done for 46 con-

secutive adolescent patients (aged 13–18, middle

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school or high school students in Korea) who un-

derwent PELD for single level **lumbar** disc hernia-

tion between June 2001 and May 2003. The inclu-

sion criteria of this study were as follows: (a) soft

**lumbar** disc herniation was demonstrated on the

computed tomographic (CT) scan and/or magnetic

resonance imaging (MRI), (b) the patients exhib-

ited radicular symptoms and/or back pain that was

consistent with the radiologic findings, and (c) un-

successful conservative therapy had been adminis-

tered for at least 6 weeks. Excluded were patients

with apophyseal ring fracture, a sequestrated frag-

ment, chronic discogenic back pain and/or severe

neurological deficits. Patients with segmental in-

stability were also excluded.

The patients’ clinical charts and radiological

examinations were reviewed. To analyze the clini-

cal outcomes, we compared the preoperative Vi-

sual Analogue Scale (**VAS**) scores of patients’ back

and leg pain with their postoperative **VAS** scores

for back and leg pain, and the Macnab criteria (1)

were checked via mailed questionnaires. A suc-

cessful outcome was defined as excellent or good

based on the Macnab criteria.

Statistical analysis was performed using the

Student *t* test, and two-tailed *p* values less than

0.05 were considered significant.

**Surgical Technique**

The procedures were performed with the pa-

tients under local anesthesia, in the prone position

on a radiolucent table. Prior to surgery, the proce-

dure, the patients were informed about all the steps

of the procedure. Patients could communicate with

the surgeon during the entire procedure.

The skin entry point was usually about 10 – 11

cm from the midline for the L4 – 5 and L5 –S1 lev-

els. For the L3–4 level, the skin entry point was

usually more medially located than for the L4–5

level, i.e., about 7–9 cm from the midline. After

the entry point was numbed with local anesthetics,

an 18-gauge spinal needle was introduced under

fluoroscopic image guidance. The final target of

the spinal needle was the medial pedicular line on

the anteroposterior image and the posterior verte-

bral line on the lateral image. An epidurogram was

then taken with contrast media to confirm the lo-

cation of the exiting root and the traversing root

(Fig. 1A). After insertion of a spinal needle into

the disc, an intraoperative discogram was per-

formed with a mixture of 6 mL of contrast media

and 1 mL of indigo carmine. The next steps were

as follows: (a) a guidewire was inserted through

the spinal needle, (b) the spinal needle was re-

moved, (c) a small skin incision was made at the

entry site, (d) a tapered, cannulated obturator was

inserted along the guidewire (e) after touching the

annulus, the obturator was inserted into the disc

after the annulotomy was performed (f) finally, a

bevel-ended, oval-shaped working cannula was in-

serted into the disc along the obturator and then the

obturator was removed (Fig. 1B, C).

First, manual **discectomy** was performed

through the cannula under fluoroscopic guid-

ance. The endoscope was inserted through the

cannula. The blue-stained disc was removed with

small forceps and a side-firing Holmium yt-

trium-aluminum-garnet (Ho:YAG) laser using

the ‘in and out’ technique, that is, working from

the central portion to the lateral portion of the

disc space on the anteroposterior image (Fig.

1D-F). The herniated fragment had a characteris-

tic feature: the intradiscal portion of the herni-

ated fragment was stained blue with indigo

carmine, but the subligamentous portion was

only slightly stained by the dye (Fig. 1G). After

removing this distinctive herniated fragment, we

removed the endoscope and applied a sterile

dressing with a one-point suture.

**Results**

The male:female ratio was 26:20. The mean

age at the time of the operation was 16.5 years. Be-

fore their operations, 44 of the 46 patients (95.7%)

suffered from low back pain and leg pain. Two pa-

tients (4.3%) presented with leg pain only. Four-

teen patients (20.4%) also showed motor weakness

before their operations. All 14 of these patients

showed weakness upon great toe dorsiflexion

(power grade IV). Three patients (6.5%) had a his-

tory of trauma before the onset of their symptoms.

The mean duration of the symptoms was 7.7

months (range: 1.5 – 36 months). The spinal levels

of PELD were L3–4 in one patient, L4–5 in 40

patients and L5 –S1 in 5 patients. The demographic

findings are summarized in Table 1.

The mean operation time was 51.4 minutes

(range: 30 – 75 minutes). One patient (2.2%) com-

plained of transient dysesthesia after the operation.

All the patients except one showed improvement

of their symptoms immediately after their opera-

tions (Fig 2). One patient (2.2%) underwent a sub-

sequent open **discectomy** because only incomplete

decompression was achieved with PELD.

The mean follow-up period was 37.2 months

(range: 25–48 months). The mean **VAS** scores of

the leg pain decreased significantly after the oper-

ations (before operation: 8.52±1.60; at the final

follow-up: 1.46±1.57, p < 0.0001). The mean **VAS**

score of the back pain also decreased significantly

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**Fig. 1. (A)** Before the insertion of the endoscopic instrument, an

epidurogram was always taken to identify the traversing root

and dorsal root ganglion. **(B, C)** Picture taken after the insertion

of the endoscopic cannula. Note the superficial location of the

endoscopic cannula. **(D)** Intraoperative endoscopic view show-

ing the herniated disc (H) that was stained blue by indigo

carmine, and the posterior longitudinal ligament (P). **(E, F)** Tar-

geted fragmentectomy was performed using a Ho:YAG laser

and forceps. **(G)** The herniated fragment removed by PELD.

Note the characteristic features of the herniated fragment.

**A**

**B**

**C**

**D**

**E**

**F**

**G**

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after the operation (before operation: 7.74±2.38; at

the final follow-up: 1.89 ±1.74, p < 0.0001). Based

on the Macnab criteria, the surgical outcomes were

excellent for 10 patients (21.7%), good for 32 pa-

tients (69.6%) and fair for 4 patients (8.7%), and so

the rate of symptomatic improvement was 91.3%.

All 4 patients with fair outcomes showed moderate

back pain at the final follow-up (mean **VAS** score:

5.8) (Table 2). Recurrent disc herniation occurred in

one patient (2.2%) at 14 months after his operation.

We instituted conservative care, and he showed a

good outcome at the final follow-up.

**Discussion**

With the evolution of such instruments as the

endoscope and the Ho:YAG laser, surgical PELD

techniques have also advanced very rapidly. As

form of minimally invasive surgery, PELD has

several advantages over conventional open discec-

tomy. For example, PELD is usually performed

with the patient under local anesthesia. Also, the

postoperative pain is quite minimal, so patients can

usually be discharged within 24 hours after PELD.

And during the procedure, the normal paraspinal

structures such as ligaments, muscle, lamina and

facet joints are preserved. Therefore, the risk of

postoperative epidural scar formation and instabil-

ity can be minimized (20, 33 – 35).

With children’s and adolescents’ **lumbar** disc

herniations, the long-term results of disc surgery

depend not only on the disc disease itself, but also

on the degree of surgical trauma. Mayer et al. rec-

ommended that disc herniations in children and

adolescents should be treated with minimally inva-

sive procedures (32). They reported on 4 patients

who underwent percutaneous endoscopic discec-

tomy for contained or small noncontained disc her-

niation, all of whom showed excellent or good re-

sults. Although we agree with the recommendation

of Mayer et al., the number of patients in their re-

port was very small. Moreover, the surgical instru-

ments and techniques of percutaneous endoscopic

procedures have improved significantly since the

time of their report. Thus, we believe that the pre-

sent study is the first large series about PELD in

adolescents that reflects the current state of percu-

taneous endoscopic surgery.

In the present study, the surgical outcomes of

PELD in adolescents were satisfactory, i.e., 91.3%

of all the patients showed successful outcomes at a

mean follow-up of 37.2 months. The surgical out-

comes in the present study were nearly the same or

better than those of open **discectomy** in adoles-

cents (4–12). When performing percutaneous en-

doscopic procedures, proper patient selection and

narrow inclusion criteria are the most important

factors for obtaining successful outcomes (20). Im-

proper selection of patients can result in incom-

plete decompression and subsequent open discec-

tomy, and this can sometimes result in a poor sur-

gical outcome. Several highly experienced endo-

scopic surgeons have recently expanded the indi-

cations for PELD and have reported successful

outcomes even in cases of migrated disc herniation

(36). However, the learning curve of PELD is usu-

ally steep and the clinical outcomes are especially

affected by the surgeon’s skill and personal tech-

**TABLE 1**

*The Demographics of the Patients Who Underwent PELD*

**Characteristics**

Number of cases

46

Gender

Male

26

Female

20

Mean age (years)

16.5

Mean duration of symptoms (months)

7.7 (range 1.536)

Level

L3 – 4

1

L4 – 5

40

L5 –S1

5

PELD = percutaneous endoscopic **lumbar discectomy**.

**TABLE 2**

*Summary of the Patients with Fair Outcomes*

**Gender/Age**

**Sx duration**

**Level**

**VAS (pre)**

**VAS (post)**

**Follow-up**

**(months)**

**BP**

**LP**

**BP**

**LP**

**(months)**

M / 15

5

L4 – 5

10

10

7

7

44

M / 17

1.5

L4 – 5

5

5

5

4

41

F / 17

24

L4 – 5

8

9

5

2

38

M / 17

5

L5 –S1

6

8

6

2

28

BP = back pain; F = female; M = male; LP = leg pain; pre = preoperative; post = postoperative; Sx = symptom; **VAS** = visual ana-

logue scale.

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**Fig. 2.** An 18-year-old boy suffered from back pain and left leg pain for 6 months. His symptoms immediately improved after

PELD. The preoperative **(A, B)** and postoperative **(C, D)** magnetic resonance images show the effective result of targeted frag-

mentectomy.

**A**

**B**

**C**

**D**

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nique (20). Therefore, in this study we adopted

narrow inclusion criteria, i.e., soft disc herniation

with radiculopathy with/without back pain that

didn’t respond to more than 6 weeks of conserva-

tive therapy. We excluded those patients who had

apophyseal ring fracture, sequestrate fragments,

chronic discogenic back pain and severe neurolog-

ical deficits. In those cases, we usually performed

open **discectomy**. In cases with spinal instability,

spinal fusion was considered the first option.

Using these indications, appropriate decompres-

sion was achieved with PELD for all patients ex-

cept one in the present study. Regarding the prog-

nostic factors for PELD, Ahn et al. have analyzed

43 consecutive adult patients who underwent

PELD for recurrent disc herniation (20). They

showed that a better outcome was obtained for the

patients who were younger than 40 years, the pa-

tients with a duration of symptoms less than 3

months and the patients who were without concur-

rent lateral recess stenosis. We believe the good

surgical outcomes that were achieved in the pre-

sent study are also attributable to the young age of

the patients. Adolescents with **lumbar** disc hernia-

tion usually do not have severe degenerative

changes such as lateral recess stenosis. Therefore,

obtaining appropriate decompression is usually

possible with PELD, which resulted in the suc-

cessful outcome of this present study.

After conventional **discectomy**, a significant

number of patients suffer from residual back pain (7,

12 – 15). Postoperative degenerative changes such as

gradual disc space subsidence and facet joint degen-

eration could explain this negative outcome (12, 20).

Unlike open **discectomy**, the posterior paraspinal

structures are preserved during PELD. Furthermore,

only the targeted removal of the herniated fragment

is usually performed during PELD. Therefore, in the

beginning of this study, we assumed that PELD

might show a better result than open **discectomy** in

terms of postoperative back pain. In the present

study, the mean **VAS** scores of back pain were sig-

nificantly decreased after PELD at a mean follow-up

of 37.2 months (from 7.74 ±2.38 to 1.89 ±1.74, re-

spectively). However, all 4 of the patients (8.7%)

who showed fair outcomes still suffered from mod-

erate back pain (mean **VAS** score: 5.8; range: 5 – 7),

although one of them underwent subsequent open

**discectomy**. Therefore, we cannot definitely say that

PELD is superior to open **discectomy** in regard to

postoperative back pain. Further long-term follow-

up evaluation is warranted to elucidate the effect of

PELD on postoperative back pain.

The most frequent complication of PELD in

this study was temporary dysesthesia, and this was

probably the result of thermal or mechanical irrita-

tion of the traversing root or the dorsal root gan-

glion (29). Temporary dysesthesia has been re-

ported to develop in up to 20% of the patients un-

dergoing PELD (24, 29). Sympathetic mediated

pain, causalgia, quadriceps atrophy, psoas muscle

hematoma and wound infections are other compli-

cations reported after PELD (24, 29, 37). Recently,

the postoperative complications of PELD have

been decreasing as a result of advances in mini-

mally invasive surgical techniques. Ahn et al. have

reported transient dysesthesia in 4.7% of their pa-

tients (20). In this series, only one patient (2.2%)

showed transient dysesthesia. Because PELD is

performed via the posterolateral transforaminal

route, the precise identification of a safe “triangu-

lar working zone” during the procedure is of ut-

most importance to avoid complications (24). In

this study, we always took an epidurogram to iden-

tify the location of both the traversing root and the

dorsal root ganglion. We then carefully checked as

to whether the patient felt severe leg pain or not

during each step of the procedure.

**Conclusions**

In selected cases, performing PELD for ado-

lescent soft **lumbar** disc herniation shows a high

success rate comparable to success rates for open

**discectomy** or chemonucleolysis. We believe that

PELD is a good treatment option for adolescent

soft **lumbar** disc herniations.

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